Poliomyelitis

(Also known as Polio, Polioviral Fever and Infantile Paralysis)

Report Immediately

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1) THE DISEASE AND ITS EPIDEMIOLOGY

A. Etiologic Agent

Polio is caused by poliovirus (genus *Enterovirus*), which has three serotypes. Type 1 virus most frequently causes epidemics and is most often isolated from paralytic cases of poliomyelitis. Type 3 and, to a lesser degree, type 2 viruses can also cause paralysis. Types 2 and 3 viruses are more likely to be associated with vaccine-associated paralytic poliomyelitis (VAPP) than are type 1 viruses.

B. Clinical Description

Infection with poliovirus results in a spectrum of manifestations. The overwhelming majority of infections (95%) are clinically inapparent. Some 4–8% of infected individuals will experience non-specific viral symptoms, such as a low-grade fever, headache, sore throat, nausea, abdominal pain, constipation, diarrhea, and/or vomiting (abortive disease). Some 1–5% of infections will result in aseptic meningitis, involving stiffness of the back, neck and/or legs, at times with paresthesias, a few days after the minor illness has resolved. Only about 0.1–1% of infections will progress to acute flaccid paralysis (AFP) with loss of reflexes in the involved limbs, usually with fever present (paralytic poliomyelitis). Please note, today in the US, the most common cause of AFP is Guillain-Barré Syndrome.

Progression to paralytic poliomyelitis usually occurs within 2–4 days and rarely continues after the fever subsides. Spinal paralysis is typically asymmetric, more severe proximally than distally. Paralysis may compromise respiration and swallowing. After the acute episode, many patients recover at least some muscle function and prognosis for recovery can usually be established within 6 months after onset of paralytic disease. Between 2–10% of paralytic infections are fatal. Risk factors for paralytic disease include larger inoculum of poliovirus, increasing age, pregnancy, strenuous exercise, tonsillectomy, and intramuscular injections administered while the patient is infected with poliovirus.

Infection with poliovirus results in life-long, serotype-specific immunity. Long-term carrier states are rare and have been reported only in immunodeficient persons.

Some 25–40% of persons who contracted paralytic poliomyelitis in childhood may develop “post-polio syndrome” 30 to 40 years later. This syndrome is characterized by muscle pain, exacerbation of existing weakness, and/or development of new paralysis or weakness. Risk factors for developing this syndrome include a) increasing time since acute polio infection, b) the presence of permanent residual impairment after recovery of the acute illness, and c) being female.

C. Reservoir

Humans are the only host.

D. Modes of Transmission

The principal mode of transmission is person-to-person by the fecal-oral or oral-oral route, with the fecal-oral

route predominating. Transmission via oral secretions, such as saliva, is possible and may account for some cases. In rare instances, the virus may be transmitted by contaminated sewage or water. Asymptomatic individuals, especially children, comprise a significant source of infections. No reliable evidence of spread by insects exists. No long-term carrier state is known. In temperate climates, poliovirus infections are most common in the summer and fall.

E. Incubation Period

- **Abortive (non-paralytic) polio:** The incubation period is usually 3 to 6 days.
- **Paralytic polio:** The incubation period is usually 7 to 21 days, with a range of 3 to 35 days.

F. Period of Communicability or Infectious Period

The period of communicability is not precisely defined. It appears greatest 7-10 days before and after onset of clinical symptoms, when poliovirus is present in the throat and excreted in the highest quantities in the feces. Poliovirus can continue to be shed in the feces for 4 to 6 weeks. Rarely, excretion of poliovirus >6 months after infection has been found in asymptomatic, immunodeficient persons. Poliovirus can be found in throat secretions as early as 36 hours and in the feces 72 hours after exposure to infection in both symptomatic and asymptomatic cases.

G. Epidemiology

Prior to the widespread use of polio vaccine, poliomyelitis occurred worldwide. Polio was epidemic in the US for the first half of the 20th century with over 20,000 cases of paralytic disease in 1952. The first inactivated poliovirus vaccine (IPV) was introduced in 1955, monovalent oral poliovirus vaccine (OPV) in 1961, trivalent in 1963, and enhanced inactivated poliovirus vaccine (eIPV) in 1987. After the introduction of vaccination, the reported number of cases of poliomyelitis in the US dropped to <100 in 1965 and <10 cases in 1973. The last cases of indigenously-transmitted wild-type poliovirus in the US were in 1979. The last two outbreaks of poliomyelitis in the US were reported among groups opposed to immunization due to their religious beliefs: in 1972 among Christian Scientists and in 1979 among the Amish. The last case of wild-type polio disease in the Western Hemisphere was detected in Peru in 1991. The Western Hemisphere was declared free from indigenous wild-type poliovirus transmission in 1994.

Approximately half of the world's population now reside in areas considered polio-free. Worldwide efforts to eradicate polio in countries where the disease is still endemic are underway. Strategies include: (1) achieving and maintaining high vaccination coverage among infants < 1 year of age; (2) developing sensitive surveillance systems for AFP and a laboratory network; (3) conducting National Immunization Days; (4) and conducting "mopping-up" campaigns to directly target geographic areas known to be high risk for polio transmission. The number of countries where poliovirus continues to be isolated has decreased substantially, with sub-Saharan Africa and southern Asia remaining the two major areas of wild-type virus circulation.

Due to the success of global efforts towards eradication and the elimination of indigenously transmitted disease in the Western Hemisphere, cases of paralytic poliomyelitis in the industrialized countries have become exceedingly rare. During the period 1980–94, there was an average of 8–9 cases of paralytic polio reported annually in the US. Most of these cases were vaccine-associated paralytic poliomyelitis (VAPP), which can occur after receipt of OPV. This very rare disease accounted for an average of 8 reported cases per year in the US, during the period 1980–94 (or 1 case for every 2.4 million doses of OPV distributed). The risk for VAPP is highest after receipt of the first dose of poliovirus vaccine, occurring at one case per 750,000 doses distributed. Since 1986, the only cases of paralytic poliomyelitis occurring in the US have been vaccine-associated.

In January 1997, in an effort to reduce the risk of VAPP, a sequential polio vaccination schedule (IPV for doses 1 and 2, OPV for doses 3 and 4) was recommended in the US. With the continued success of worldwide efforts to eradicate poliovirus and in the interest of eliminating completely the occurrence of VAPP, an all-IPV immunization schedule was initiated on January 1, 2000 in the US.

Despite the great achievement in polio eradication in the US, we need to remain vigilant of the possibility of importation of wild poliovirus from areas of the world where it is endemic. The importation of wild poliovirus from polio-endemic regions of the world may occur among under-immunized (1) tourists, (2) immigrants revisiting their countries of origin, or (3) members of religious groups, regardless of travel history. In 1992–93 an outbreak occurred in the Netherlands among members of a religious group that refuse immunization. Poliovirus has also been isolated from members of a similar religious group in Canada, although no cases of disease occurred.

2) REPORTING CRITERIA AND LABORATORY TESTING SERVICES

A. What to Report to the Massachusetts Department of Public Health

- A suspect or confirmed case of polio, as diagnosed by a healthcare professional, or
- Acute onset of flaccid paralysis (AFP) especially in an unvaccinated individual or in a member of a community that refuses immunizations (please see clinical case definition under "Additional Information" at the end of this chapter), or
- Neurologic symptoms suggestive of polio infection in a recipient or contact of a recipient of oral polio vaccine (OPV), or
- Isolation of poliovirus from an individual, whether or not that individual is believed to have been exposed to poliovirus or to have received OPV, or
- Significant rise in anti-poliovirus antibody titers comparing acute and convalescent serum specimens.

B. Laboratory Testing Services Available

***Note*: Please contact the Massachusetts Immunization Program at (617) 983-6800 for assistance if polio is suspected.**

1. **Isolation:** Stool, throat, and cerebrospinal fluid (CSF) clinical specimens should be collected. A stool specimen is the most likely source from which to isolate poliovirus, although isolation of virus from stool alone does not constitute proof that poliovirus is the causative agent. A throat specimen, followed by CSF, is the next likeliest source for virus. Isolation of poliovirus from CSF is diagnostic, although it is rarely accomplished. The Massachusetts State Laboratory Institute (SLI), Virus Isolation Laboratory can perform techniques to isolate enteroviruses, including poliovirus (serotypes 1, 2, and 3), echovirus, coxsackievirus (A and B), and Enteroviruses (70 and 71) from all of these clinical specimens. If poliovirus is isolated, testing can be performed at the Centers for Disease Control and Prevention (CDC) to determine if it is a vaccine or wild-type strain.

   Specimen Collection for Isolation
   To maximize the likelihood of isolating poliovirus, at least two stool and two throat swab specimens should be collected 24 hours apart as early in the course of the illness as possible. **Stool** should be collected in a sterile clinical cup (transport medium is not needed). **Throat swabs** (either Dacron or cotton-fiber) should be collected and transported in viral transport medium. Ideally, specimens should be collected as soon as possible, but no later than 15 days after the onset of symptoms. Stool specimens collected $\geq$ 2 months after onset of paralytic manifestations are unlikely to yield poliovirus. Sterile **CSF** ($\geq$ 1mL) should also be collected, if possible.

   Clinical specimens should be sent to the SLI Viral Isolation Laboratory (617-983-6382) within 24 hours of collection. If specimens cannot be sent immediately after collection, they may be stored at 4°C but should **NOT** be frozen. The MDPH may contact the CDC Enterovirus Laboratory at (404) 639-2749 for consultation regarding submission of specimens for confirmatory testing.

2) **Serology:** Serologic testing for poliovirus infection should also be performed. Acute and convalescent

specimens are tested for evidence of a rise in neutralizing antibodies to each of the three poliovirus serotypes. A fourfold rise in neutralizing antibody between the acute and convalescent specimens is suggestive of acute poliovirus infection. Serologic testing cannot distinguish between infection by vaccine or wild-type strains. False-negative results may occur in immunocompromised persons who are at highest risk for paralytic disease. False-negative results may also occur because neutralizing antibodies appear early in the course of infection and may already be at high levels by the time sera are collected, and titers may not change.

Specimen Collection for Serology
Three specimens should be collected serially. An acute-phase serum specimen should be obtained as early as possible in the course of illness. A convalescent-phase specimen should be obtained 3-4 weeks after the acute specimen, and, if possible a third specimen should be obtained 3-4 weeks after the second specimen. All specimens should be collected in red-capped tubes and serum separated, if possible. Specimens may be sent at room temperature or on ice to the SLI Viral Serology Laboratory (617-983-6396) as a pair or separately. Specimens may be stored at 4°C once they have been serum separated. While serologic testing for poliovirus is not available at the SLI, appropriate specimens will be forwarded to the CDC for testing.

3) DISEASE REPORTING AND CASE INVESTIGATION

A. Purpose of Surveillance and Reporting

- To distinguish between wild-type and vaccine-associated polio and to identify susceptible people exposed to wild-type polio.
- To maintain indigenous transmission of wild-type poliovirus at zero.
- To identify cases of VAPP that might occur secondary to immunization with OPV given in another country.

B. Laboratory and Healthcare Provider Reporting Requirements

Refer to the lists of reportable diseases (at the end of this manual's Introduction) for specific information.
Note: Due to the potential severity of polio, the Massachusetts Department of Public Health (MDPH) requests that information about any case be **immediately reported** to the local board of health where diagnosed. If this is not possible, call the MDPH Division of Epidemiology and Immunization at (617) 983-6800 (weekdays) or (617) 983-6200 (nights/weekends).

C. Local Board of Health Reporting and Follow-Up Responsibilities

MDPH regulations (*105 CMR 300*) stipulate that each local board of health (LBOH) must report the occurrence of any case of polio (as defined by the reporting criteria in Section 2A). Refer to the *Local Board of Health Reporting Timeline* (at the end of this manual's introductory section) for information on prioritization and timeliness requirements of reporting and case investigation.

Note: The MDPH requests that information about any suspect or known case of polio be **immediately reported** to the MDPH Division of Epidemiology and Immunization by calling (617) 983-6800 (weekdays) or (617) 983-6200 (nights/weekends).

Note: Due to national surveillance and reporting requirements, the Massachusetts Immunization Program (MIP) takes the lead on polio case investigation (including filling out the official case report form) and disease control recommendations, in collaboration with the local board of health. MIP will keep the local board of health informed of all significant developments and will request the assistance of the board of health as needed.

D. Initial Questions to Ask Healthcare Provider and Patient

In order to assess the likelihood that a suspect case is a true case prior to laboratory testing, MIP and/or other public health staff helping in the investigation should ask about: 1) clinical information, 2) polio immunization history of case and close contacts, 3) pertinent medical history including underlying

illness/immunosuppression, 4) membership in religious/social group that might refuse immunization, 5) country of origin and length of residence in US, 6) recent history of travel (where and dates), 7) whether there were any recent out-of-town visitors (from where and dates), and 8) whether occupation entails handling of specimens that might contain poliovirus (*e.g.*, lab work).

4) CONTROLLING FURTHER SPREAD

Note: This section provides detailed control guidelines that are an integral part of case investigation. LBOHs should familiarize themselves with the information. However, the MIP will take the lead on implementing control measures, in collaboration with the local board of health.

Suspected cases of polio require an immediate investigation with collection of laboratory specimens as appropriate (please Section 2B: Laboratory Testing Services Available). Control measures, including the orchestration of an OPV vaccination campaign, will be initiated as quickly as possible, to contain further transmission. If circulation of poliovirus is suspected, an active search for other cases that might have been misdiagnosed (*e.g.*, Guillain-Barré Syndrome, polyneuritis, transverse myelitis) will be initiated. If evidence suggests that disease is related to receipt of OPV, no control measures are necessary because live, attenuated poliovirus vaccine strains have not been documented to cause outbreaks.

A. Isolation and Quarantine Requirements (*105 CMR 300.200*)

The Isolation and Quarantine Requirements (promulgated November 1998, printed July 1999) are out of date. Current recommendations of CDC and MDPH (as of 2000) are as follows:

Minimum Period of Isolation of a Suspect or Confirmed Case
Place case on enteric precautions for six weeks after onset of symptoms or until poliovirus can no longer be recovered from feces (the number of negative specimens needed will be determined by the MIP on a case-by-case basis).

Minimum Period of Quarantine of Contacts
Please refer to Section 4) B directly below.

B. Protection of Contacts of a Case

1. Implement control measures as described below before laboratory confirmation. While indigenous transmission of wild-type poliovirus in the United States (and the Western Hemisphere as a whole) has not occurred since 1991, the importation of poliovirus from polio-endemic regions may occur among under-immunized (1) tourists, (2) immigrants revisiting their countries of origin, or (3) members of religious groups who might refuse immunization, regardless of travel history. Polio-endemic regions include Africa, Asia, the Middle East, and eastern Europe. An MDPH epidemiologist can help assess the likelihood of exposure to wild-type polio.

   OPV is still being used outside of the US. Vaccine-associated paralytic poliomyelitis (VAPP) should also be considered as a cause of paralysis, especially if a patient has onset of paralysis after receipt of a first dose of OPV. No control measures are indicated if the case is determined to likely be VAPP. It is also possible that the case of paralysis is due to an infectious agent other than poliovirus, such as enterovirus, or due to some other noninfectious cause, and therefore not contagious. Therefore, it is **crucial that laboratory testing be initiated** to determine if the causative agent of paralysis is poliovirus and to differentiate wild-type from vaccine strain poliovirus.

2. Identify individuals or groups who may have been exposed to the case. Also, attempt to identify the route of introduction of poliovirus into the community. To identify these groups, think in terms of “zones of exposure” and consider members of the following groups:

- Household members
- School/daycare associates (students/attendees and staff)
- Staff and patients at medical facility where patient was cared for, especially if there was the potential for direct contact with feces or oral secretions
- Religious/social groups
- Sports teams and other extracurricular groups
- Bus mates
- Close friends
- Travelers from polio-endemic regions such as Africa, Asia, the Middle East and eastern Europe
- Any other persons who may have come in direct contact with the case's feces or oral secretions

3. Identify high-risk susceptibles who had contact with the case during infectious period:
   - Pregnant women should be referred to their obstetricians. (In daycare or school settings remember to determine whether teachers, student-teachers, staff or students are pregnant.)
   - Immunocompromised individuals should be referred to their healthcare providers.
   - Infants < 6 weeks of age (who are too young to have been vaccinated) should be referred to their pediatricians.
   - Members of communities who tend to refuse immunization.

4. Identify and vaccinate all other susceptibles $\geq$ 6 weeks of age with IPV (if not contraindicated). These are individuals without proof of immunity, including those with medical or religious exemptions to immunization. Proof of immunity to poliovirus is defined as:
   - For children (< 18 years of age): documentation of receipt of $\geq$ 4 doses of polio vaccine with a minimum interval of 4 weeks between doses; only 3 doses are needed when the third dose is given on or after the fourth birthday.
   - For adults ($\geq$ 18 years of age): documentation of receipt of $\geq$ 3 doses of polio vaccine with a minimum interval of 4 weeks between doses with documentation of $\geq$ 1 booster dose.

   Remember, an individual who has received a primary series consisting of $\geq$ 3 doses of vaccine AND has received $\geq$ 1 booster dose does **NOT** need to receive another dose.

   Note:
   - Vaccinating an exposed individual who may be incubating poliovirus is **not** harmful.
   - Immune globulin (IG) has been found to be of no value as postexposure prophylaxis and is **not** recommended.

     (If the use of OPV for a mass vaccination campaign to control a polio outbreak in the US is indicated, the CDC will advise the MDPH on how to obtain an emergency supply of OPV, who should receive OPV, and any other pertinent control measures.)

5. Apply precautions and isolate/exclude as follows:
   - Case: Place on enteric precautions and exclude for 6 weeks after onset or until virus can no longer be recovered from feces (the number of negative specimens needed will be determined by the MIP on a case-by-case basis).
   - Contacts: Administer IPV; do not exclude.

6. Surveillance
   Active surveillance for acute flaccid paralysis and other symptoms of polio infection should continue for at least 2 incubation periods (*i.e.*, up to 70 days) beyond the onset of the last case in an area.

C. Preventive Measures

Vaccination, including routine childhood vaccination, catch-up vaccination of adolescents, and targeted vaccination of high-risk adult groups, is the best preventive measure against polio. Good personal hygiene (particularly proper handwashing) is also very important.

1. **Routine Polio Childhood Immunization Recommendations**
   An all-IPV polio immunization schedule is now the recommended schedule. OPV is **no longer recommended** and is **not** available in the US. Four doses of IPV are usually needed to complete the primary series: doses are recommended at ages 2 months, 4 months, 6-18 months, and 4–6 years. At least 28 days are needed between doses, although a 6–8 week interval is preferred between doses 2 and 3 and a 6-month interval is preferred between doses 3 and 4. Only 3 doses are needed when the third dose is given on or after the fourth birthday. Polio vaccine is not routinely recommended for those $\geq$ 18 years unless there is potential for exposure.

2. **Polio Vaccine and Adults**
   Routine vaccination of persons $\geq$18 years of age residing in the US is **not** necessary. However, polio vaccination is indicated for the following groups:
   - Laboratory workers who handle poliovirus;
   - Health care workers caring for polio patients;
   - Persons traveling to regions of the world where polio is endemic or epidemic.

3. **Polio Vaccination and Travel**
   In assessing the risk to a traveler for polio transmission, healthcare providers are urged to determine first if their patients will truly be traveling to a polio endemic or epidemic area, including Africa, Asia, eastern Europe, or the Middle East. If access to the internet is available, please follow the link <http://www.cdc.gov/travel> to obtain information on the risk of transmission of poliovirus in specific countries. Or contact the CDC's Traveler's Health Office at (877) 394-8747. In addition, a Division of Epidemiology and Immunization epidemiologist can be reached at (617) 983-6800 or (888) 658-2850 to help make this determination.

   If travel to a polio-endemic or epidemic region is anticipated, please review the patient's history of polio immunization. Ninety percent or more of vaccine recipients develop protective immunity to all three poliovirus types after two doses, and at least 99% are immune following three doses.
   - If the patient has received a complete primary series of $\geq$ 3 doses of polio vaccine, administer a booster dose of IPV. Remember, a single booster dose is all that is needed.
   - If the patient is unimmunized or partially immunized, follow an accelerated schedule to complete as much of the series as possible before departure, as outlined in the table below:

Weeks Available	Accelerated IPV Schedule*
$\geq$ 8 weeks	3 doses, given 4 weeks apart
4-7 weeks	2 doses, given 4 weeks apart
< 4 weeks	1 dose

*1st dose may be given as early as 6 weeks of age

Please refer to the most current versions of MDPH's *Childhood and Adult Immunization Guidelines* and *Massachusetts Immunization Program-Supplied Vaccines and Patient Eligibility Criteria* for details about polio vaccination, the recommended schedule, who should and shouldn't get the vaccine, and who is eligible to receive state-supplied vaccine. These as well as other relevant resources (including a *Polio Public Health Fact Sheet*) are available through the Division of Epidemiology and Immunization at (617) 983-6800 or (888) 658-2850 or through the MDPH website at <http://www.state.ma.us/dph/cdc/epiimm2.htm>.

ADDITIONAL INFORMATION

The following is the formal CDC surveillance case definition for polio. It is provided for your information only. It is not necessary to use this information for reporting or investigating a case. (CDC case definitions are used by the state health department and CDC to maintain uniform standards for national reporting.) For reporting to the state, always use the criteria outlined in Section 2) A.

Clinical case definition for paralytic poliomyelitis:
Acute onset of a flaccid paralysis of one or more limbs with decreased or absent tendon reflexes in the affected limbs, without other apparent cause, and without sensory or cognitive loss.

Case classification
Probable: A case that meets the clinical case definition.

Confirmed: A case that meets the clinical case definition and in which the patient has a neurologic deficit 60 days after onset of initial symptoms, has died, or has unknown follow-up status.

REFERENCES

American Academy of Pediatrics. *Red Book 2000: Report of the Committee on Infectious Diseases, 25th Edition*. Illinois, American Academy of Pediatrics, 2000.

CDC. Case Definitions for Infectious Conditions Under Public Health Surveillance. *MMWR*. May 2, 1997; 46:RR-10.

CDC. *Epidemiology & Prevention of Vaccine-Preventable Diseases: The Pink Book, 5th Edition*. CDC, January 1999.

CDC. *Manual for the Surveillance of Vaccine-Preventable Diseases*, CDC, 1999.

CDC. Poliomyelitis Prevention in the United States: Updated Recommendation of the Advisory Committee on Immunization Practices (ACIP). *MMWR*. May 19, 2000; 49:RR-5.

CDC. Poliomyelitis Prevention: Recommendation of the Immunization Practices Advisory Committee (ACIP). *MMWR*. January 29, 1982; 31:3, pp. 22–26, 31–34.

CDC. Public Health Dispatch: Outbreak of Poliomyelitis—Dominican Republic and Haiti, 2000. *MMWR*. 2000; 49, pp. 1094-1095.

Chin, J., ed. *Control of Communicable Diseases Manual, 17th Edition.* Washington, DC, American Public Health Association, 2000.

MDPH. *The Comprehensive School Health Manual*, MDPH, 1995.

MDPH. *Childhood Immunization Guidelines*. MDPH, February 2000.

MDPH. *Health and Safety in Child Care: A Guide for Child Care Providers in Massachusetts.* MDPH, 1995.

MDPH. *Regulation 105 CMR 300.000: Reportable Diseases and Isolation and Quarantine Requirements*. MDPH, Promulgated November 1998 (Printed July 1999).